In order to determine whether the character of this curve is altered by exposing the protein to ultraviolet light experiments were made with egg albumin which had been freed from ammonium sulfate by dialyzing for a long time against tap water. The albumin was exposed at 0° C.: samples were then placed in tubes and heated to various temperatures in a water bath. The tubes were centrifuged and the volume of coagulum estimated. The method gave only approximate results. However, they were consistent, and the differences in the amount of coagulum obtained under the various conditions were so great that it is evident that the temperature-time curve for coagulation, by heat, of egg albumin which has been exposed to the light, is of the same general form as the one given by Chick and Martin. But the curve lies at all points from 10° to 15° C. below the one given by them.

The chief result of these experiments is that two reactions are involved in the coagulation of proteins by light: the chemical change caused by the light, and the production of a visible coagulum. The light reaction has a very low temperature coefficient, while the reaction producing the visible coagulum has a much higher temperature coefficient. It is probable that similar relations exist in other biochemical and physiological processes which result from the action of light.

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THE BOTANICAL SOCIETY OF AMERICA

THE annual meeting of the Botanical Society of America was held in the Chemical Building of Western Reserve University, Cleveland, Ohio, December 31 to January 2, 1913.

The following officers were elected for the ensuing year:

President—D. H. Campbell, Leland Stanford University.

Vice-president—M. A. Howe, New York Botanical Garden.

Treasurer—Arthur Hollick, New York Botanical Garden.

Councilor—George F. Atkinson, Cornell University.

These with R. A. Harper and William Trelease, councilors, and George T. Moore, secretary, constitute the council for 1913.

The following botanists were elected to associate membership: Robert F. Griggs, Ohio State University; Alfred P. Dachnowski, Ohio State University; Warner Jackson Morse, Maine Experiment Station; L. Lancelot Burlingame, Leland Stanford University; John J. Thornber, University of Arizona; James Theophilus Barrett, University of Illinois; Arlow Burdette Stout, New York Botanical Garden; Ezra Brainerd, Middlebury, Vt.; Norman Taylor, curator, Brooklyn Botanic Garden; William Dana Hoyt, fellow by courtesy, Johns Hopkins University; Edward M. Gilbert, University of Wisconsin; Lester Whyland Sharp, Alma, Michigan; William Skinner Cooper, Carmel, California.

A symposium on "Permeability and Osmotic Pressure" was held January 1, participated in by Professors Jacques Loeb, Harry C. Jones, W. J. V. Osterhout and Burton E. Livingston. The papers will be printed in the *Plant World*.

The address of retiring President W. G. Farlow, on "The Change from the Old to the New Botany in the United States,"[1] was delivered at the dinner for all botanists, on the evening of January 1.

Amendments to the constitution, making it possible for all those actively interested in botanical work to become eligible for membership and providing for "fellows," were adopted. The dues for 1913 were made $1.00. Active steps for the publication of a botanical journal by the society were taken.

First Generation Hybrids between Œnothera Lamarckiana and O. cruciata: GEORGE H. SHULL, Carnegie Institution.

Constant Variants of Capsella: HENRI HUS, University of Michigan.

Pedigree cultures from the original individual proved the existence of constant forms, not previously reported. Some of these apparently are not identical with the biotypes previously described by Shull. Emphasis is laid on the importance of the study of seedling stages, since, for purposes of identification, climax leaves may be relied upon under certain conditions only.

[1] SCIENCE, January 17, 1913.

The Problem of the Origin of Œnothera Lamarckiana De Vries: B. M. DAVIS, University of Pennsylvania.

The identification of Lamarck's evening primrose, *Œnothera Lamarckiana* Seringe 1828 (*O. grandiflora* Lamarck ?1798), as a form of *Œnothera grandiflora* Solander 1789,[2] has materially changed the situation with respect to the origin of the plant which has been the subject of such extensive experimentation by Professor De Vries. *Œnothera Lamarckiana* Seringe becomes a synonym of *O. grandiflora* Solander and the plant of De Vries's cultures is left without a name or at least without the authority of Seringe. I have proposed in the paper cited above that the name *Lamarckiana* be kept for De Vries's plant and that the name be written *Œnothera Lamarckiana* De Vries. The retention of the old name is justified by the fact that the *Lamarckiana* of De Vries's cultures is not known as a native species in any part of the world and there is good reason for believing that the plant has come down to us as a hybrid and a product of a long period of cultivation. To change the name of this plant made famous by the studies of De Vries would carry endless confusion through the literature of experimental morphology.

Œnothera Lamarckiana De Vries first appeared on the market when introduced by the firm of Carter and Company, seedsmen in London, about 1860. There is evidence from a sheet in the Gray Herbarium[3] that this plant underwent certain modifications during the twenty-five years that elapsed before De Vries began his studies upon *Lamarckiana.* The problem of the origin of *Œnothera Lamarckiana* then centers on the history and composition of the cultures of Carter and Company.

Carter and Company state that they received their seed unnamed from Texas. If this is correct we have reason to hope that thorough exploration in the south and west may bring to light large-flowered œnotheras from which *Lamarckiana* might have been derived either directly or indirectly as a hybrid. American botanists have then the problem of the discovery and isolation by culture of any large-flowered œnotheras in the south and west which might have had a direct relationship to *Lamarckiana* or which might have been one of the parents of a possible cross. The rediscovery of *Œnothera grandiflora* Solander in Alabama was a good beginning in this search, but the search should be pushed further. There is thus a tangible problem of whether or not such forms are or ever were present as native American species. If they were present in Texas in 1860 they may surely be expected there to-day.

The fact that large-flowered œnotheras were established in England as early as 1806 in localities (as the sand hills of Lancashire) which are at present occupied by extensive growths of *Lamarckiana* suggests the possibility that *Lamarckiana* was in England before 1860 and that the cultures of Carter and Company may have come not from Texas but from some part of England, and that their association with a Texan source may have been some mistake on the part of the seedsmen. English botanists have the problem of the history of such *Œnothera* floras as that of the Lancashire sand hills, and collections should be searched with great thoroughness for herbarium sheets that may be of assistance in tracing its development.

With Lamarck's plant, grown in Paris about 1796, identified as a form of *Œnothera grandiflora* Solander there has developed a much clearer situation than formerly when attempts were made to place the time of the introduction into Europe of *O. Lamarckiana* De Vries at various dates previous to 1778, the year when *O. grandiflora* Solander was introduced at Kew. There is then on historical grounds no evidence why *Lamarckiana* De Vries might not have arisen in England after 1778 as a hybrid between forms of *grandiflora* and forms of *biennis.* This is the working hypothesis which is receiving strong support from my experimental studies with hybrids between strains of *biennis* and *grandiflora.*

An exhibit of hybrids between *Œnothera biennis* and *O. grandiflora* that resemble *O. Lamarckiana* De Vries was then discussed.

The Experimental Demonstration of the Validity of the Biological Doctrine of Recapitulation: E. C. JEFFREY, Harvard University.

The Plant Formations of the Nebraska Sandhills: R. J. POOL, University of Nebraska.

The sandhills of Nebraska cover an area of approximately 20,000 square miles, which lies to the north and west of the central portion of the state. The soil of the upland is a straw-colored sand mostly of Tertiary origin. This sand has been blown into innumerable dunes which cover the

[2] See Davis, *Bull. Tor. Bot. Club,* November, 1912.

[3] See Davis, *Amer. Nat.,* XLVI., p. 417, 1912.

underlying rocks of the Arikaree formation with a loose porous soil varying in depth from a few feet to over 150 feet. Wind action is still a pronounced factor in shaping the topography of the uplands, although the region as a whole is practically stabilized by invading vegetation. The influence of wind is reflected most forcibly at present in the regions of active "blow-outs" and "sand-draws."

The greater part of the upland in this great dune region is effectively held against wind erosion by the Bunch-grass Association, a sub-division of the Prairie Grass Formation. Another conspicuous association of the upland is the Blow-out Association. The valleys are characterized by less xerophilous association which in the main are members of the Prairie Grass Formation to the east. The Short Grass Formation has pushed in from the west in a number of places and has occupied especially the hard land in some of the valleys. Forest formations are found along streams and spring branches that are related to the central hardwoods region and to the Rocky Mountain forest region. The streams, wet valleys and numerous lakes reveal the presence of a number of marsh and aquatic associations which are in the main similar to such associations found farther eastward in the Prairie Grass Formation.

The International Phytogeographic Excursion of 1911 and 1913: H. C. COWLES, University of Chicago.

In August, 1911, there was held in the British Isles under the auspices of the British Vegetation Committee the first International Phytogeographic Excursion. A dozen phytogeographers from six different countries were conducted to the places in England, Scotland and Ireland where the natural vegetation is of greatest interest. In all the places visited there were competent British guides, who were very familiar with the vegetational features to be considered. The guiding spirit of the excursion was Dr. A. G. Tansley, of Cambridge, who accompanied the party throughout the tour, and attended to numberless details.

Among the many valuable features of the British excursion were (1) the opportunity of getting intimately acquainted in a short time with the most important features of the British vegetation; (2) the opportunity to know in intimate fashion the British botanists who accompanied the party and who were met from place to place, and to know with special intimacy the foreign colleagues with whom we were associated closely every day for a month; (3) the opportunity to discuss the problems of vegetation as we met them together in the field, and thus without misunderstanding one another and with the certainty that we were talking about the same things.

It was the unanimous opinion of those who participated in the British excursion that the benefits to all were so considerable that similar excursions should be made a permanent feature of International Phytogeography, and at frequent intervals. The second excursion has been definitely announced for the United States in August and September, 1913, and it has been suggested that a third excursion be held on the continent of Europe, immediately after the conclusion of the London Botanical Congress in 1915. It is hoped that American botanists, and especially those interested in the advance of ecology and plant geography, will cooperate in every way possible to make the excursion of 1913 a great success.

Prairie Openings in a Forest Region: B. SHIMEK, Iowa State University.

A prairie opening on the exposed terminus of a ridge near Iowa City, Iowa, has retained its original prairie flora through all the changes incident to the clearing of much of the surrounding country and the building of an electric railway which cuts a part of the ridge.

The distinction between the flora of this area and an adjoining timbered tract is sharply brought out by comparative lists of the plants. The plants of the latter area are broad-leaved, and the leaves present a distinct dorsi-ventral structure, while those of the prairie are narrow-leaved, and the leaves are often more nearly erect or ascending.

A comparison of evaporation and transpiration on the two areas shows that evaporation is much greater on the open surface, but that transpiration may be less.

An artificial opening, created by a road-clearing through the original forest near Homestead, Iowa, more than fifty years ago, is similarly discussed with reference to its flora. The greater part of the area is somewhat sandy, and the road-strip, which is about fifty feet wide, extends almost due north and south through about a mile of forest.

This roadway has been kept clear of larger brush and small trees which occasionally spring up, and as a result a very characteristic prairie flora has taken possession of most of the roadside.

Both areas are discussed with reference to their bearing on the question of the causes of the treelessness of the prairies, and the fact is emphasized

that prairie fires especially could not have been the cause.

Vegetation Features of the Columbus Quadrangle: A. DACHNOWSKI and F. B. H. BROWN.

The Genus Helianthus in Southern Michigan: S. ALEXANDER.

This paper involves the recognition of a large number of new forms. An attempt is made to classify sunflowers on the basis of their underground systems and of their venation.

The Regulatory Formation of Tannase in Aspergillus niger and Penicillium sp.: LEWIS KNUDSON, Cornell University.

Aspergillus niger, Penicillium rugulosum and *Penicillium* sp., can ferment tannic (gallotannic) acid, gallic acid resulting. Employing the two organisms *Aspergillus niger* and *Penicillium* sp., the writer made experiments in which a modified Czapek's solution was employed as the nutrient medium. When the source of carbon is tannic acid, gallic acid or cane sugar supplemented by tannic or gallic acids at certain concentrations, these organisms form the enzyme tannase. In the absence of tannic or gallic acids no tannase is formed. In these experiments the effect of each of fourteen other organic compounds was tested, but none could stimulate the formation of the tannase. The gallic acid is not as efficient as the tannic acid in stimulating to formation by these organisms the enzyme tannase.

In certain experiments the influence of concentration of tannic acid on the quantity of the tannase produced was determined. The source of carbon was 10 per cent. sugar supplemented by tannic acid in variable quantities. It was found that the greater the concentration of tannic acid present the greater is the quantity of the enzyme tannase produced. The greatest quantity of enzyme is produced when tannic acid is the sole source of carbon. In other experiments the source of carbon was 2 per cent. tannic acid, and variable quantities of cane sugar employed. It was found that the higher the concentration of cane sugar the less is the quantity of tannase produced.

The Relation of Ventilation to the Respiration of Fruits: GEORGE R. HILL, JR., Missouri Botanical Garden.

A study was made of the respiration and other metabolic phenomena of green and well-ripened fruits which had been placed in nitrogen, hydrogen air and carbon dioxide. Cherries, blackberries, green, market-ripe and very ripe peaches, ripe red Astrachan apples and Concord and Catawba grapes were used. Particular attention was given to an investigation of the common cold storage injury to peaches, "ice-scald," and the results point quite definitely to a close relationship between it and anaerobic respiration. The keeping qualities of the fruits in storage in the gases named, and the relation of these to ventilation, was also considered. The experiments were run in triplicate and the temperature was kept constant by an apparatus devised especially for the purpose.

Conditions Affecting the Development of Lycopin in the Tomato: B. M. DUGGAR, Missouri Botanical Garden.

Willstätter and Escher have shown that the red pigment of the tomato (lycopin, solanorubin) and carotin (derived from the carrot) are isomeric compounds, readily distinguishable by their physical properties. In the ripening tomato both lycopin and carotin occur. An experimental study of the effects of various conditions upon ripening demonstrates that while carotin is developed under conditions of growth differing widely, lycopin is formed only within a limited range of metabolic activity. Temperature and oxygen supply are two of the factors indirectly limiting lycopin development. In yellow varieties of the tomato "carotin" only is found, and in red varieties lycopin formation is precluded by high temperature, yellow fruits resulting. Irreversible effects are not produced by heat. Red tomatoes seem to contain a factor for redness superimposed upon the factor or factors for yellow, and this conclusion is borne out by breeding experiments.

A Chemical and Physiological Study of After-ripening of the Rosaceæ: SOPHIA ECKERSON.

The Hawthorn is one of the few seeds where there is known to be a dormancy of the embryo. A period of "after-ripening" is necessary before germination is possible. Food is stored in the embryo as a fatty oil. Neither starch nor sugar is present. The reaction of the cotyledons is acid, but the hypocotyl is slightly basic. The water-absorbing power of the hypocotyl is less than 25 per cent. of the wet weight.

There is a series of metabolic changes in the embryo during the period of after-ripening. The initial change seems to be an increased acidity. Correlated with this is an increased water-holding power, and an increase in the activity of catalase and peroxidase. Near the end of the period of after-ripening there is a sudden greater increase in the acidity, and in the water content. All of

these increase until the hypocotyl is 3–5 cm. long. At this time the fats decrease and sugar appears.

The after-ripening period can be shortened greatly by treating the embryos with dilute solutions of HCl, butyric and acetic acids. The water-holding power, the acidity and the activity of peroxidase increase much more rapidly than in the untreated embryos.

The Use of Celloidin Membranes for Demonstration of Osmosis: G. M. SMITH, University of Wisconsin.

The membranes were prepared by pouring a 10 per cent. solution of celloidin on a dish of clean mercury and, after allowing the celloidin to dry sufficiently to be lifted, it was placed over the end of a thistle tube, tied down and allowed to harden. Two membranes were made, one over the other; the double membranes proving themselves ten times as strong as the single ones. The tensile strength of the membrane was found by setting up the osmometer and pouring in mercury and noting the height of the column, when the rupture of the membrane occurred. The double membranes stand over three atmospheres pressure without breaking.

The membranes were rendered semipermeable by putting a M/20 potassium ferrocyanide solution inside of the osmometer and immersing the apparatus in a M/20 copper sulphate solution. A good membrane is formed within the celloidin in three days. When a celloidin membrane separates water and a 3M cane sugar solution the liquid in the osmometer will rise about seven feet in three days and then sink; but when the celloidin membrane contains a copper ferrocyanide precipitate the liquid will rise about twenty-five feet in ten days and then slowly sink.

Studies of Osmotic Pressure: M. A. BRANNON, University of Chicago.

This report is based upon studies made in the plant physiological laboratories at the University of Chicago. The work extended over a period of ten months. The measurements of osmotic pressure were made by cryoscopic methods, the Beckmann apparatus being employed to determine the freezing points of the solutions used.

Three different kinds of potatoes were chosen. They were placed in controlled conditions so that only one limiting factor, heat, was involved in the experiments. One collection of potatoes was placed in an icebox where a temperature of 2° C. was maintained and one collection was kept at a temperature of 25° C.

At the beginning of the experiments the osmotic pressure of the different potatoes was about 7 atmospheres. After ten months the icebox potatoes had developed a maximum osmotic pressure of 13 atmospheres. The lower temperature favored metabolic activities resulting in the liberation of an acid, a catalyte and the fermentation of foods, stored in the form of starch and hemicellulose. The change from colloids to crystalloids was accompanied by the rise in osmotic pressure noted.

The fermentation of the hemicellulose was indicated microscopically by the great reduction in the thickness in the cell walls of the potato tissue affected, and also by the great increase in the brittleness of the potato tissues involved.

These studies are suggestive of the changes taking place in the after ripening of seeds, tubers and bulbs, and has a definite relation to several economic and scientific problems.

Protoplasmic Contractions Resembling Plasmolysis which are caused by Pure Distilled Water: W. J. V. OSTERHOUT, Harvard University.

True plasmolysis can be produced only by solutions which are hypertonic, but appearances almost or quite undistinguishable from it may be brought about by hypotonic solutions. Some light is thrown on the nature of this result by a study of certain cases in which it is caused by pure distilled water. Material for such study is afforded by marine plants.

The root tips of the eel grass (*Zostera marina*) are well adapted to this purpose. The root tips were carefully removed from the sand in which they were growing and immediately placed in sea water.

The application of distilled water causes a contraction of the protoplasm which often closely resembles the true plasmolysis produced by hypertonic sea water (which has been concentrated by evaporation) or by hypertonic sugar solutions. The mode and the degree of contraction vary somewhat, but in general the variations in true plasmolysis are of the same sort, as in what may be conveniently called the false plasmolysis. We may use the term false plasmolysis to designate not only the contraction produced by distilled water, but also that which is caused by certain hypotonic solutions.

The Effect of Anesthetics on Permeability: W. J. V. OSTERHOUT, Harvard University.

Experiments were performed to test the elec-

trical conductivity of living tissues in various solutions. The results show conclusively that a great variety of ions readily penetrate living cells and that this penetration may be markedly hindered or accelerated by the addition of various substances to the solution. The addition of anesthetics, such as ether and chloroform, has a retarding effect on the penetration. It would seem, therefore, that these substances should retard all physiological processes which depend on the transport of ions through living tissues.

Plants which Require Sodium: W. J. V. OSTERHOUT, Harvard University.

It is generally believed that plants do not require sodium, although it is indispensable for animals. Our increasing knowledge of the biological rôle of salts makes it clear that such a distinction between plants and animals is of fundamental importance, provided it be true in all cases. But if exceptions to it be found its significance largely disappears. I have therefore undertaken to ascertain whether or not there are plants which require sodium and have begun by examining some marine plants. The results are as follows:

The marine plants studied require sodium; its replacement in sea water by NH_4, Ca, Mg, K, Ba, Sr, Cs, Rb or Li is very injurious.

The best substitutes for Na are the other salts of the sea water, Mg, Ca and K.

The diversity in behavior of various species toward the salts which were used to replace the sodium shows that each of these salts has a specific rôle in life processes.

Studies of the Wild Oat: W. M. ATWOOD, University of Chicago.

Avena fatua (L.) has become a pest agriculturally in the small grain regions of the north and west. In studying its germinative qualities we have found it to possess high vitality. This differs from the deductions which might be drawn from the results of other workers who have tested the seed after periods of burial in the ground.

Avena fatua germinates poorly after harvest, but the per cent. of germination increases steadily up to the succeeding spring and summer.

The early delay of germination appears to be due neither to the chemical condition of the embryo nor to coat obstructions to water entry. Oxygen seems to be the limiting factor to germination which can be forced by breaking the coats or increasing the oxygen pressure.

Investigations are now under way to determine whether the so-called "after-ripening" of the seed is due to alterations in the oxygen demands of the embryo or to increased permeability of the coat to oxygen.

Toxicity of Smoke: LEE J. KNIGHT and WILLIAM CROCKER, University of Chicago.

Molisch has found tobacco smoke extremely toxic to plants of various kinds ranging from bacteria to the highest angiosperms. He finds this toxicity is not due to volatilized nicotine, for cellulose paper smoke is as toxic, but believes it is due to CO.

In the burning of organic compounds the destructive distillation carbon-bearing gases, CO, C_2H_2, C_2H_4 and CH_4 are not generally completely burned and may be the source of injury in the smoke. Exact experiments on the delicate sweet-pea seedling, Early Cromer, shows that smoke from cigarettes, cigars and cellulose paper cigarettes does not contain sufficient CO, C_2H_2 or CH_4 to determine 1/200 the toxicity of the smoke. This leaves C_2H_4, which we have already shown as extremely toxic to plants, as the substance probably determining the toxicity. The injury from smoke in our cities has been attributed to SO_2 and SO_3, so far as gases are concerned. The possible effect of the dry distillation of carbon-bearing gases has been entirely neglected. They are produced in small amounts in the burning of coal. This coupled with their extreme toxicity (especially ethylene) makes them probable factors in the smoke question.

A Delicate Test Seedling: WILLIAM CROCKER, LEE J. KNIGHT and R. CATLIN ROSE, University of Chicago.

We have already published on the characteristic response that the etiolate of sweet pea seedlings give to ethylene. It has been termed a triple response, since it is marked by reduction in rate of elongation, increased growth in diameter and diageotropism. We have since studied the effect of more than fifty gases and vapors upon the seedling, including the paint solvents, the possible impurities of laboratory air, the main constituents of illuminating gas and the principal distillation products of coal tar. The seedlings are apparently reliable and extremely delicate in testing for ethylene—2,000 to 5,000 times as delicate as gas analysis methods. While a few other gases and vapors, carbon monoxide, acetylene, benzene, toluene, xylene, thiophene, cumene and others give the triple response they must be present in such quantities as to be easily detected by other means or they are excluded through impossibility of their

presence in the gas studied. We believe the response of this seedling furnishes a very delicate means of detecting the presence of "heavy hydrocarbons" in laboratory and greenhouse air, in smoke of all sorts and in furnace gases.

The Heat of Absorption of Water in Wood: FREDERICK DUNLAP, U. S. Department of Agriculture.

The heat evolved when water wets dry wood has been studied with the Bunsen ice calorimeter. Oven-dry wood was used; this was sealed in glass to prevent premature wetting. The wood and water were both cooled to 0° C. and brought together at this temperature and the heat evolved was measured. This is large enough to raise the dry wood entering into the reaction from 0° to about 50° C. Under the assumption that the specific heat of wet wood is the sum of the specific heats of the wood and water present in wet wood, its temperature would be raised to about 30° C.

The substance of wood as distinct from the cavities of the cell lumina is saturated when it has imbibed about 25 per cent. of its weight of water. The first per cent. imbibed produces a relatively great evolution of heat; the twenty-fifth, a relatively small evolution of heat, the curve connecting the two being convex upward.

Wood is hygroscopic and its moisture content varies with that of the atmosphere about it. The "working" of wood is due to changes of volume of its substance with changing moisture content. Measures to prevent this "working" aim either to remove the wood from the action of the atmosphere or to render it insensitive to changes in the atmosphere by destroying its hygroscopicity, at least in part. Experiments whose aim it is to destroy the hygroscopicity of wood are now in progress in the Forest Products Laboratory, and this method will be used in studying the changes produced.

Artificial Parthenogenesis in Fucus: J. B. OVERTON, University of Wisconsin.

The occurrence of natural parthenogenesis has been reported for several species among the Phæophyceæ. It is evident that this group shows a strong tendency to develop without fertilization and that natural parthenogenesis may play an important part in the life history of several species. Although Thuret mentions that unfertilized eggs of *Fucus* kept for several days become pear-shaped and that a cellulose wall is sometimes present, none of the Fucaceæ have been described as being able to develop without fertilization.

While working at the Marine Biological Laboratory the past summer, the well-known experimental methods of certain animal physiologists, whereby unfertilized eggs of certain animals have been made to develop under the influence of artificial physical and chemical stimuli, were applied to *Fucus* eggs. In plants used for experiment care was taken to prevent contamination by sperms. That female plants may be made perfectly sterile by washing in fresh water is shown by the fact that none of the eggs of such sterilized plants ever developed in the numerous controls which were run in connection with the experiments. In experimenting, the eggs used at any one time were divided into three lots. One lot was used as a control, another was fertilized and the third was placed for one third minute in a mixture of 50 c.c. of sea-water + 3 c.c. 0.1 *m* acetic or butyric acid. A large number of the eggs treated with these solutions become invested with a cell-wall in about 10 minutes. This wall is exactly similar to the one formed about normally fertilized eggs. The wall is readily seen by plasmolyzing the eggs. After the formation of the membranes, if the eggs are transferred to hypertonic sea-water for 30 minutes and then are brought back into normal sea-water, development continues. Such eggs become pear-shaped, showing a rhizoidal papilla, and by next day have cleaved. If the cultures are kept properly aerated, sporelings of about 25 cells develop in the laboratory, resembling in every respect those grown from fertilized eggs.

It would appear that the action of the acid in inducing cell-wall formation about unfertilized *Fucus* eggs is similar to the action which calls forth membrane formation in the animal egg. Considerable evidence exists indicating that the essential condition for the formation of the fertilization membrane in such eggs is an increased permeability of the plasma membrane to substances which harden in contact with sea-water. That the first effect of the sperm upon *Fucus* eggs is to cause cell-wall formation is apparent from the observations of several investigators.

No attempt was made to grow the sporelings under natural conditions. The methods used by Hoyt and Lewis are suggestive and it seems probable that the sporelings produced parthenogenetically could be grown to sexual maturity, so that the nuclear behavior during oogenesis and spermatogenesis might be investigated.

The Periodicity of Algæ: E. N. Transeau, Illinois State Normal School.

The preliminary observations on algal periodicity given in this paper are based upon a study of eighteen hundred collections made at many stations in eastern Illinois during the past five years. The general richness of the waters of this region may be judged by the fact that the genus *Œdogonium* is represented by more than forty-five species and *Spirogyra* by thirty-five. Field observations indicate that sexual reproduction in nature is induced by a more definite combination of environmental factors than asexual, since the former is usually restricted to a short period of time, while the latter may occur at intervals or continuously throughout the vegetative period of the algæ.

On the basis of the time of greatest frequency, duration of the vegetative cycle and time of reproduction, algæ may be classified as follows:

1. *Spring Annuals.*—Forms whose vegetative period begins in late autumn, reaches its maximum in April and May and is followed by a decline in June. Fruiting occurs in April, May and June.

2. *Summer Annuals.*—Vegetative period begins in spring, culminates in July and August, followed by decline in autumn. Fruiting occurs in July, August and September.

3. *Autumn Annuals.*—Vegetative period begins in spring and early summer, culminates in autumn, decline comes with the beginning of freezing temperatures. Fruiting occurs in October and November.

4. *Winter Annuals.*—Vegetative period begins in autumn, continues through the winter under the ice and culminates in early spring. Fruiting occurs from November to April.

5. *Ephemerals.*—Forms having a vegetative period of a few weeks or days. Fruiting occurs at intervals during all but the winter months.

6. *Perennials.*—Vegetative period continuous with irregularly distributed maxima. Reproduction takes place during the spring, summer and autumn.

7. *Irregulars.*—Forms in which the combinations of conditions necessary for good vegetative development and reproduction occur at irregular intervals, usually of more than a year's duration.

Algæ fruit most abundantly during periods of high water following favorable conditions for vegetative development, rather than during periods of "concentration of the water," "drying up of the ponds," or the coming of "hard conditions." The drying up of pools may coincide with the fruiting of many vernal species, but it results in decreasing the number of spores formed and the number of species that fruit.

The time of fruiting of many algæ is dependent upon combinations of environmental factors rather than on "hereditary rhythm."

A more complete account of these observations will be found in the *Transactions of the American Microscopical Society,* Vol. 32, No. 1, 1913.

On the Presence of Diastase in certain Red Algæ: E. T. Bartholomew, University of Wisconsin.

In the *Florideæ,* starch granules are deposited outside the chromatophores. The granules do not usually give the characteristic reaction when subjected to iodine or zinc chloriodide, but instead turn brown to wine-red. To determine whether or not a diastase is present which will act in the ordinary way on the starch of green plants, extractions were made from the following: *Polysiphonia variegata, Ceramium* sp., *Dasya elegans* and *Agardhiella tenera.* A cornstarch paste was treated with various concentrations of these extracts, and after given periods of time tested with Fehling's solution and with iodine. The results showed that although starch digestion was much slower in the tubes treated with the algal extract than in those treated with common commercial diastase, yet the digestion went on and in time was complete; usually taking from six to nine days. In the tubes treated with the algal extract the iodine color-reactions showed that probably a series of dextrins was formed before the starch was completely digested. No doubt the great viscosity of the algal extract materially retarded its action on the paste. By running a series of controls, careful check was kept on each set of experiments. It appears, therefore, that there is present in the *Florideæ* a diastase similar to that found in green plants.

Cytological Studies on Sphæroplea: E. M. Gilbert, University of Wisconsin.

Investigation has shown that many statements made by Klebahn and Golenkin with regard to *Sphæroplea* are inaccurate.

No conspicuous pit-like depressions have been found in partition walls as described by Golenkin.

Cleavage, in the formation of eggs, begins with constrictions from the plasma membrane, and cuts the cell contents into masses of varying sizes. All stages, from those having a single row of large eggs to those having a double row of small eggs may be found in one filament, indicating the possi-

bility that Klebahn saw stages in a single form and not two distinct varieties. I have been unable to find a fusion of many nuclei in the egg as described by Golenkin, nor a multinucleated egg as described by Klebahn.

All nuclear divisions are mitotic, not simply the earlier divisions as noted by Golenkin. There is no fragmentation of the nucleolus to form the chromosomes.

Fertilization does not take place until the egg is fully formed and rounded up; at this time the egg nucleus lies in the center of the egg.

The pyrenoids vary greatly as to size and shape, and the starch is often found to be very irregularly arranged around the central structure.

A Comparison of Plant and Animal Spermatogenesis: CHARLES E. ALLEN, University of Wisconsin.

The development of the androcyte of *Polytrichum juniperinum* into the antherozoid is in several respects closely parallel to the corresponding metamorphosis of the spermatid in certain animals, notably in mammals. For present purposes comparison will be made with the spermatogenesis of the guinea-pig, well known through the researches of Meves.

1. In both spermatid and androcyte the nucleus is at first central, then comes to lie at the extreme side or end of the cell. It undergoes a great diminution in volume, its contents becoming denser and finally homogeneous. The nucleus of the spermatid is finally flattened and curved into the form of the bowl of a spoon; that of the androcyte is drawn out into a long spiral filament.

2. The spermatid possesses two *central bodies;* the androcyte contains the blepharoplast, whose centrosomic nature is a disputed question. From one of the central bodies a contractile filament grows out which becomes the axial filament of the vibratory *tail.* From the blepharoplast grow out two cilia. Out of the central bodies is developed the *end knob* or *middle piece* of the spermatozoon; the blepharoplast forms the anterior end of the antherozoid; in each case the part of the male cell in question is that to which the motile apparatus is attached.

3. The *sphere* or *idiozome* of the spermatid divides into two portions; one, the *acrosome,* forms the anterior end of the spermatozoon; the other, a spherical mass, passes to the posterior part of the cell and is finally discarded with other unused portions of the cytoplasm. The young androcyte contains a spherical body which, like the idiozome, divides into two; one lies close to the anterior end of the blepharoplast, and perhaps persists in the mature antherozoid as a delicate sheath about the blepharoplast; the other, which has been called by Ikeno (incorrectly) the *chromatoid Nebenkörper* and by M. Wilson the *limosphere,* places itself in contact with the posterior end of the elongating nucleus and is discarded with the remaining cytoplasm after the antherozoid becomes free.

4. The androcyte contains a small spherical body which seems to persist but a short time and has no discoverable function; it may be compared with the *chromatoid Nebenkörper* or with the *Nebenkern* of the spermatid, both of which are conspicuous, but temporary and apparently functionless.

5. That part of the cytoplasm in both spermatid and androcyte which is not used in forming the mature cell rounds up into a vesicle; this cytoplasmic residue is discarded by the spermatozoon before maturity, and by the antherozoid after its escape from the antherid.

How far the similarities noted are due to a series of homologies, and how far to the fact that a similar problem is to be worked out by two cells similar but of widely divergent origin, must be left for the present an open question.

Intermingling of Perennial Sporophytic and Gametophytic Generations in Rusts: E. W. OLIVE, Brooklyn Botanic Garden.

The Individuality of Chromosomes in the Somatic Cells of Gentiana procera: R. H. DENNISTON, University of Wisconsin.

The nuclei in the cells of the nucellus and integument were the ones especially studied.

The material is favorable, because the chromatin appears in the resting stages in deeply stained, well-defined masses.

In this plant there is a large number of chromosomes, about eighty. These appear closely massed together in the equatorial plate stage.

In the metaphase the chromosomes are pulled away from each other toward their respective poles. In this view the chromosomes appear as short curved rods.

The chromosomes do not lose their identity in the diaster stage, as here and there an individual can be plainly seen projecting from the mass.

The long axes of the individual chromosomes conform in general direction with the long axis of the spindle.

After the closely packed condition of the chromosomes in the diaster, they move apart somewhat,

each group appearing to occupy more space. At this time no apparent change in the density or size of individuals has taken place, but their axes now lie in many directions. The nuclear membrane appears and the nucleus has the form of an oval with the shorter diameter in the direction of the spindle. It may be that the spreading apart of the chromosomes is for the purpose of facilitating their growth, as they now appear somewhat larger. Probably the chromosomes do not grow, but become less dense, since they do not stain so intensely at this time. The nucleoles make their appearance as small oval bodies, from one to four in number. These usually combine later, to form a single nucleole.

The chromosomes now appear to become angular and to lose their curved form. Threads of linin appear and portions of the chromatin appear to be drawn out along these threads. No continuous spirem is formed, however. The chromosomes now come together in groups, forming various-sized homogeneous, angular masses. This is the condition in which the chromatin is found in the greater number of so-called resting cells in the Gentian. There are also present small particles of chromatin material along the linin threads which connect the larger masses. There is no uniformity in the number of the larger masses, and in this plant there is no indication of prochromosomes, *i. e.*, there is no relation between the number of chromosomes and the number of these masses.

Each mass appears to be composed of smaller fairly distinct bodies, but these smaller bodies do not represent the chromosomes, since they are much more numerous and vary in size. These small bodies later become arranged along the linin thread, forming a spirem.

The spirem increases rapidly in diameter, takes a homogeneous stain, and occupies a peripheral position in the nucleus. Irregularities on the surface of the spirem suggest the position of the chromatin bodies of which it was made up. Segmentation of the spirem follows and the chromosomes are formed.

These are long at first, but soon shorten to rod-like bodies, three or four times as long as broad. They are distributed throughout the nucleus and pairing does not appear to take place.

The main points in the history of the chromatin in the somatic cells of this plant are:

1. The aggregation of chromosomes in the diaster, from which, later, the chromosomes separate out.

2. The absence of a dispirem.

3. The presence in the resting nucleus of chromatin masses which vary in size and shape.

4. The breaking up of these chromatin masses into smaller fragments, more numerous than the chromosomes.

Physiological and Economic Significance of the Structure of the Tracheids of Conifers: I. W. Bailey, Harvard University.

The so-called striated tracheids of conifers are a specialized type of tissue structurally organized to resist compression. Gothan's hypothesis that "spiralstreifung" are spiral cracks confined to heartwood, and are produced by chemical changes and mechanical stresses in the transformation of alburnum into duramen, is not substantiated by a study of the origin and distribution of striations in the various coniferous genera.

Cracking or slitting of tracheid walls in drying occurs sporadically and is confined to the so-called summerwood. Tiemann in his "slit" theory of the penetration of gases and preservatives into seasoned wood has not taken into consideration the important fact that drying-cracks do not rupture the middle lamella and are confined to the secondary and tertiary walls. Injection experiments show that the membranes of bordered pits in freshly cut green sapwood are perforated and permeable to gases, colloids and finely divided solids held in suspension.

The Leaf Trace and Pitting of the Araucarineæ and their Relation with those of the Cordaitalean Forms: R. B. Thompson, University of Toronto.

The venation of the Araucarian and Cordaitalean leaves is typically dichotomous, though in some of the modern forms a false trichotomy has been acquired. In both groups the dichotomous condition persists in the secondary wood, *double traces* extending to the pith in many instances. The bundles of the double trace are far apart in the seedling of *Agathis*. Ginkgo has been up to the present the classical example of the double trace in the secondary wood for comparison with the Cordaitalean forms. The double trace in the *cortex* of the Abietineæ has been considered a vestige of this condition.

In pitting, the cone and root of the Araucarineæ show a more accentuated Cordaitalean character than that of the stem. The ordinary tracheids of the cone, for example, may have the pits as much as 5-seriate and extending from end to end of the tracheid. The ray-pitting of the tracheids retains

the multi-seriate condition longer than the adjacent part, where tracheid is in contact with tracheid. This is a contrast to some of the Abietineæ where the ray pitting consists of "Grosseiporen" derived from the fusion of smaller pits.

Both leaf traces and pitting are considered as indicating the Cordaitalean connection of the Araucarineæ and as directly opposed to the derivation of the Araucarineæ from the Abietineæ. The anatomical evidence is thus in accord with the geological, since, as has been recently shown, the forms of the older strata which were thought to have been Abietinean have proved not to be authentic.

Macrozamia Moorei, a Connecting Link between Living and Fossil Cycads: C. J. CHAMBERLAIN, University of Chicago.

A Possible Means of Identifying the Sex of + and — Strains in the Mucors: A. F. BLAKESLEE, Carnegie Institution.

Certain of the hermaphroditic species of the mucors are distinctly heterogamic, forming regularly large female gametes and smaller male gametes. By growing the (+) and (—) races of an isogamous dicecious species in contrast with such an heterogamic hermaphroditic species, a sexual reaction has been found to occur between female branches of the hermaphrodite and branches of the (—) race, on the one hand, and between male branches of the hermaphrodite and branches of the (+) race on the other hand. This reaction would lead one to consider the (—) race male and the (+) race female.

A Suggestion as to the Phylogeny of the Ascomycetes: ERNST A. BESSEY, Michigan Agricultural College.

Of the two suggested points of origin of the Ascomycetes, the Phycomycetes are excluded in view of their non-septate plant body and the simplicity of the structures resulting from the sexual union. Many of the red seaweeds, on the other hand, have a plant body in many respects similar to that of the Ascomycetes, *i. e.,* septate with a single rather large pit or pore in the septum, the segments being in both groups either uni- or plurinucleate. In both groups, the result of the sexual union is a "spore fruit," *i. e.,* a more or less extensive mass of branches from the female cell terminating in the reproductive cells. The fact that a number of red seaweeds are known which lack chlorophyll and are strictly parasitic upon other algæ (red seaweeds), very often surrounding and separating the cells of the host in a manner similar to that shown by the lichens with reference to their hosts and the fact that in the reproduction of the latter group, *e. g., Collema,* the male elements are, as in the red seaweeds, non-motile sperm cells, suggests that lichens may represent a group derived from some of the more primitive red seaweeds, probably inhabitants of fresh water, that became parasitic upon colonies of Nostoc or other algæ and gradually assumed the terrestrial habit. The apothecium would correspond to the cystocarp and the ascus would phylogenetically have some relation to the carpospore. From such lichens have been derived then the non-lichen Discomycetes, on the one hand, and perhaps through the closing and becoming more firm of the apothecium, may have arisen the Pyrenomycetes. Similarly the teliospores of the rusts and smuts would be homologous to the carpospore.

Morphogenesis in Pediastrum: R. A. HARPER, Columbia University.

In the genus *Pediastrum* we find all degrees of variation in cell differentiation from species in which the colonies are composed of cells which are practically all alike to others in which only the peripheral cells are provided with well-developed spines, while in the central region the spinous projections are only slightly indicated by the kidney-shaped form of the cells with the reentering angle on the outer side. In the species with uniform cells these may show either very long spinous processes or almost none at all. The reproduction of the colonies by motile zoospores, which after swarming for from five to fifteen minutes arrange themselves spontaneously in the plate-shaped new colony shows that as in *Hydrodictyan* the form of the colony is not predetermined by any spatially differentiated representation of the adult in the organization of the germ plasm. The cells arrange themselves in accordance with the principle of least surfaces modified by their specifically inherited cell form and the law of reproduction by bipartition. All the cells of a given species are in general alike in their inherited form and capacities for differentiated growth, and are totipotent. The differentiation between cells in species which show it is due to cellular interaction in the formation and growth of the colony. This morphogenetic equivalence of the cells is most clearly shown in cases in which the cells are abnormally or unusually situated as a result of unfavorable environmental conditions. All the species share an inherited tendency to produce one or two spines

on one side of the cell. The degree to which these spines are developed in a given colony is determined by cellular interactions. The degree to which the tendency is present in different species is the basis for the delimitation of species in the genus. All the cells show also a polar differentiation, the spines being produced in the direction of the shorter of the two major axes of the cell. There is some evidence also of specifically oriented attractions between the cells such that the spines in normal individuals come to point radially outward in the interior as well as in the peripheral cells of the colony. Specifically inherited cell form and cellular interactions during growth are the principal morphogenetic factors in the development of the differentiated cell colonies of *Pediastrum*.

Tetradesmus, a New Four-celled Cœnobic Alga: G. M. Smith, University of Wisconsin.

Tetradesmus resembles *Scenedesmus* in the number and shape of the cells, but differs from it in the cellular arrangement, the cells being in two planes, each plane containing two cells.

The reproduction is by autocolonies. The first cleavage of the mother cell is transverse and the second is in the same plane and diagonal to the line of the first cleavage. After the four daughter cells have been formed by cleavage they elongate, while still within the mother cell, taking the same relative position that they have in the mature colony. The young colony is liberated by a longitudinal rupture of the mother cell wall.

The mature cell possesses a nucleus and a pyrenoid. The nucleus divides once before the first cleavage takes place, but the pyrenoid does not. When the four daughter cells have been formed, the old pyrenoid of the mother cell is found in one of them while the other three contain no pyrenoid. This pyrenoid then disappears and pyrenoids are formed *de novo* at the time that the daughter cells are elongating prior to their liberation from the old mother cell wall.

The Relation of the Lichen to its Algal Host: Bruce Fink, Miami University.

The common algal hosts of lichens; finding the algal hosts growing near lichens in nature; cultures of lichens from spores and spermatia with and without the algal hosts; cultures of the algal hosts separately; growth of lichen hosts and other algæ on media with and without light and carbon dioxide; breathing pores and other means of aeration of the algal hosts in lichens; lichens as carriers of food to the algal hosts; hypotheses regarding the relationship of the lichen and its algal host, with evidence from recent research.

A Dry Rot of the Irish Potato Tuber: E. M. Wilcox, University of Nebraska.

In 1908 our attention was called to the fact that potatoes grown in western Nebraska were often seriously injured by a form of rot during storage. Comprehensive investigations were undertaken to learn the exact cause and nature of this disease. It was found to be due to a new species of *Fusarium,* shortly to be published as *Fusarium tuberivorum* Wilcox and Link. Numerous inoculation experiments have established the causal relation of this organism to this tuber dry rot. The organism is, however, unable to invade any other part of the plant than the tuber, and the tuber only when it is practically mature.

The Propagation of Medicinal Plants: F. A. Miller.

An Optimum Culture Medium for a Soil Fungus: J. B. Pollock, University of Michigan.

The work was done in collaboration with Miss Rose M. Taylor, and had for its object the determination of an optimum culture medium of exactly known composition and of simple constitution. The fungus chosen was one isolated from the soil by H. N. Goddard, and determined as a new species of Myceliophthora, to be described by him elsewhere under the name of *Myceliophthora sulphurea*. The medium aimed at was one with the fewest and simplest compounds which would furnish the chemical elements necessary for the growth of fungi. It is known that fungi will grow with as few as eight of the known elements, namely, carbon, hydrogen, oxygen, nitrogen, sulphur, phosphorus, potassium and magnesium. In the experiments sixteen organic compounds were tested as to their availability for carbon, and incidentally they could also supply hydrogen and oxygen. These carbon compounds were saccharose, dextrose, maltose, inulin, lævulose, arabinose, mannite, cellulose, resin, starch, glycocoll, alanin, asparagin, glycerine, potassium tartrate and sodium benzoate. The compounds tested as to their availability for nitrogen were ammonium sulphate, ammonium nitrate, sodium nitrate, potassium nitrate and calcium nitrate. In all the cultures magnesium sulphate was used to supply magnesium and sulphur. This was used in only one concentration, 1/1000 that of a gram-molecular solution = 1/1000 M. Mono-potassium phosphate was used to furnish phosphorus and potassium, and it was used in several concentrations, 1/10,

1/25, 1/50 and 1/100 M. Nitrogen compounds were used in concentrations of 1/5, 1/25, 1/125, 1/250 and 1/500 M. Preliminary experiments soon showed that this fungus could not obtain carbon from several of the compounds tried and that others had only slight availability. Only maltose, saccharose and dextrose were tried out for final results, in concentrations of 1, 2/5, 1/5, 1/10, 1/25, 1/125, 1/250, 1/500, 1/625 M.

Twenty-four sets of cultures were carried through, the number of flasks in a set ranging from six to forty-eight. The test applied for the optimum medium was the amount of vegetative growth, estimated by the eye alone in the early stages of growth for all the cultures, but in cases where the results were doubtful and also for the purpose of getting quantitative results for some of the work, in several sets the growth was determined by weight.

Conclusions.—Of the nitrogen compounds tried calcium nitrate was the best. Its best concentration was 1/250 M. 1/125 and 1/500 M were nearly as good. Sodium nitrate was next best, ammonium sulphate was very decidedly the poorest. In the early stages of growth ammonium nitrate was little better than ammonium sulphate, but given a longer time it became equal to potassium nitrate, and the latter was only slightly below sodium nitrate.

The different concentrations of the phosphate had little influence on the amount of growth, 1/10, 1/50 and 1/100 M being almost equally good, except that with cellulose as the carbon compound little growth was made with the concentration of the phosphate 1/50 or 1/100 M, while there was very good growth in 1/10 M.

Among the carbon compounds maltose was decidedly the best when ammonium nitrate was the source of nitrogen, but with calcium nitrate saccharose was as good or better. For all the three carbon compounds saccharose, dextrose and maltose, the concentration of 1 M was strongly inhibitive of growth. In 1/5 M the growth was far better than in any of less concentration. The experiments in which 2/5 M was used gave a slightly greater total than 1/5 M, but the rate of growth in the former was decidedly slower than in the latter. It was true in a good many sets of cultures that the rate of growth was more rapid in the more dilute solutions, though maximum growth occurred in more concentrated solutions.

Of the substances and concentrations tried the optimum medium for the fungus tested was:

Saccharose	2/5 M.
Calcium nitrate	1/250 M.
Monopotassium phosphate	1/10–1/100 M.
Magnesium sulphate	1/1000 M.

Saccharose has one very decided advantage over both dextrose and maltose. It may be obtained in a purer form. The ordinary rock candy obtainable at any candy store is far more nearly chemically pure than the grades of maltose and dextrose obtained from reliable dealers and labeled C.P. This is a very decided advantage in critical culture experiments.

A Labeling Surface for Laboratory Glassware: A. F. BLAKESLEE, Carnegie Institution.

Diamond ink applied to glassware gives a permanent ground-glass surface upon which labels can be written with lead pencil. Labels upon this surface are of especial value upon flasks, test tubes, etc., that need to be sterilized in autoclav.

GEORGE T. MOORE,
Secretary

SOCIETIES AND ACADEMIES

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON

THE 465th regular meeting of the Anthropological Society of Washington, D. C., was held at Room 43 of the new building of the National Museum at 4:30 P.M., January 21, 1913, Mr. George R. Stetson, the president, in the chair.

Dr. Tom. A. Williams, M.B., C. H. Edin., M. Corresp. Etrang. Soc. de Neurologie de Paris, Soc. de Psychol. de Paris, etc., charter M. Am. Psychopath. Assoc., Collaborator *Jour. Abnorm. Psychol.*, read a paper on "The Dream in the Life of the Mind."

Trance, vision, ecstasy and disease-delirium are closely allied to the dream state. The psychopathology of them all illuminates formerly uncomprehended diseases. In a dream (illustrated by a case) mental perturbation may crystallize, as it were, and lead to rampageous behavior. On the contrary, dreams may be teleologically beneficial; as where a vision saved a young woman from suicide, as was the case also with Benvenuto Cellini.

They are more often a mere reproduction of former experiences, more or less significant and more so in psychopathic individuals, such as in a young hysteric who dreamed of falling down wells, assassinations and deaths, all painful experiences of her childhood.

Their sexual nature, believed inevitable by a certain school, is not so regarded by the author.